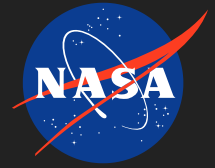


# Advanced Physical Models and Numerical Algorithms to Enable High-Fidelity Aerothermodynamic Simulations of Planetary Entry Vehicles on Emerging Distributed Heterogeneous Computing Architectures

Completed Technology Project (2015 - 2020)



## Project Introduction

The design and qualification of entry systems for planetary exploration largely rely on computational simulations. However, state-of-the-art modeling capabilities introduce substantial limitations in providing accurate and reliable predictions for aerothermodynamic flow environments of such entry, decent, and landing vehicles. These challenges are attributed to (i) the complexity of coupled multiphysical processes; (ii) limited experimental data for model validation; and (iii) the absence of advanced numerical algorithms and physical models for the accurate and efficient simulation of aerothermodynamic flows. By addressing these issues, the overall objective of this research is the development of advanced high-order numerical methods and high-fidelity physical models for the reliable prediction of aerothermodynamic flows that are relevant to hypersonic and atmospheric entry vehicles. Novel programming paradigms will be used for accelerating multiphysics simulation codes on emerging heterogeneous computing architectures. Combined, these modeling capabilities will provide improved predictions of heat-transfer, particle-laden reacting flows, and hypersonic environments to support the development of next-generation entry, descent, and landing systems.

## Anticipated Benefits

The overall objective of this research is the development of advanced high-order numerical methods and high-fidelity physical models for the reliable prediction of aerothermodynamic flows that are relevant to hypersonic and atmospheric entry vehicles.



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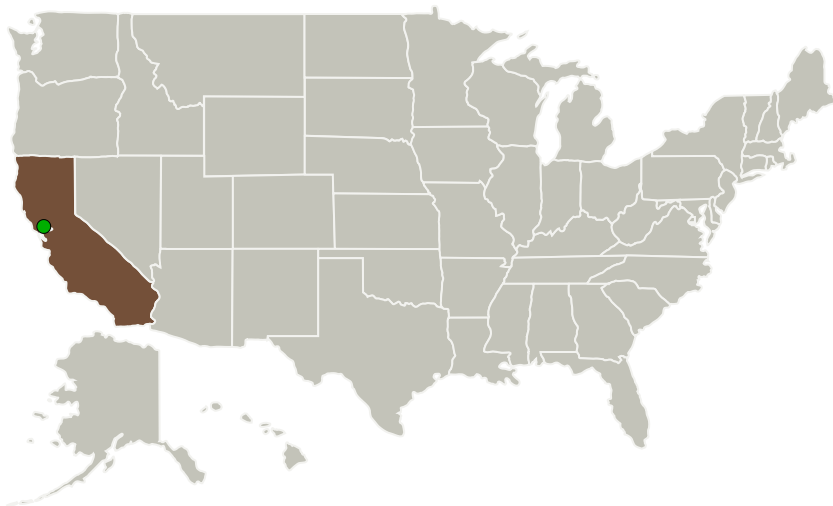
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Stanford University(Stanford)	Lead Organization	Academia	Stanford, California
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

## Primary U.S. Work Locations

California

## Project Website:

<https://www.nasa.gov/strg#.VQb6T0jJzyE>

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Stanford University (Stanford)

### Responsible Program:

Space Technology Research Grants

## Project Management

### Program Director:

Claudia M Meyer

### Program Manager:

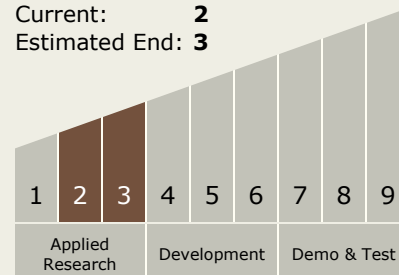
Hung D Nguyen

### Principal Investigator:

Werner M Ihme

## Technology Maturity (TRL)

Start: 2  
Current: 2  
Estimated End: 3



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## Technology Areas

### Primary:

- TX09 Entry, Descent, and Landing
  - └ TX09.4 Vehicle Systems
    - └ TX09.4.5 Modeling and Simulation for EDL

## Target Destination

Outside the Solar System